Diffusion Models Beat GANs on Image Synthesis

Year: 2021 | Citations: 9979 | Authors: Prafulla Dhariwal, Alex Nichol

Abstract

We show that diffusion models can achieve image sample quality superior to the current state-of-the-art generative models. We achieve this on unconditional image synthesis by finding a better architecture through a series of ablations. For conditional image synthesis, we further improve sample quality with classifier guidance: a simple, compute-efficient method for trading off diversity for fidelity using gradients from a classifier. We achieve an FID of 2.97 on ImageNet 128$\times$128, 4.59 on ImageNet 256$\times$256, and 7.72 on ImageNet 512$\times$512, and we match BigGAN-deep even with as few as 25 forward passes per sample, all while maintaining better coverage of the distribution. Finally, we find that classifier guidance combines well with upsampling diffusion models, further improving FID to 3.94 on ImageNet 256$\times$256 and 3.85 on ImageNet 512$\times$512. We release our code at https://github.com/openai/guided-diffusion